The Islamic University of Gaza

Faculty of Engineering

Electrical Engineering department

Electric Circuits for Computer and Industrial Engineering

Principles of electrical engineering ECIV 2321

First Mid Exam

November 4^{th} , 2010

Instructor: Eng. Nahed El-Shurafa

T.A.: Eng. Roba Abu Eleis

Exam Time: 9:00 – 11:00

Name	
ID Number	
Grade	

Read the following:

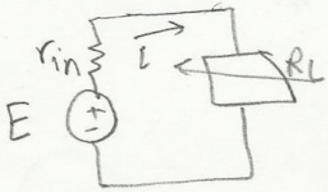
- You have limited time (2 hours) for this exam.
- There are 4 questions in this exam: you must complete all the questions.
- Stay calm, work steadily, First solve the question you know best. If you get stuck on a problem, move on to attempt the others first.

" اللهم لا سهل إلا ما جعلته سهلا ، وأنت تجعل الحزن إذا شئت سهلا "

الله ولي التوفيق

Question 1

a) How do you find the parameters of an equivalent circuit of a real voltage source?



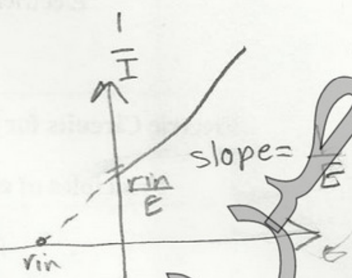
$$I = \frac{E}{R_L + r_{in}}$$

$$I = \frac{E}{R_L} + \frac{E}{r_{in}}$$

$$\frac{1}{I} = \frac{R_L}{E} + \frac{r_{in}}{E}$$

$$\frac{1}{I} = \frac{1}{E} R_L + \frac{r_{in}}{E}$$

$$y = mx + a$$



5

b) If V0=150v find V1 , V2 and Ig

apply KCL on nod ⓐ

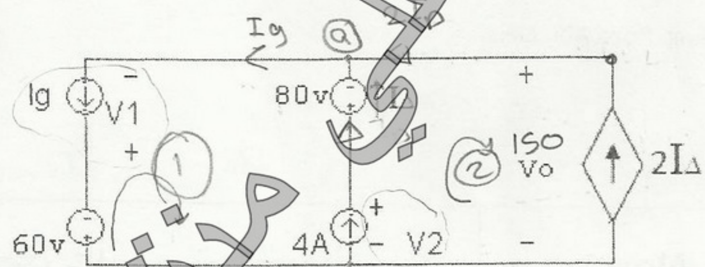
$I_D + 2I_D = I_g$

$3I_D = I_g$

but $I_D = 4A$

$4 \times 3 = I_g$

$I_g = 12A$

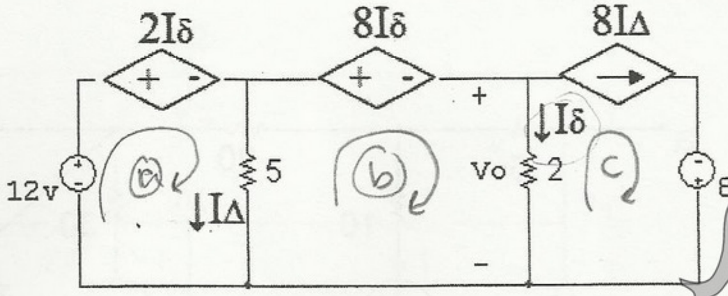


To find V_2 apply KVL in ②

$V_1 = -150 - 60 = -210$

$V_2 = 150 - (-80) = 230\ V$

C) Calculate I_Δ , V0 and I_δ



Apply Mesh in (a)

$12 - 2I_Q = 5I_a - 5I_b \rightarrow (1)$

Apply Mesh in (b)

$-8I_Q = -5I_a + 7I_b - 2I_c \rightarrow (2)$

Apply Mesh in (c)

$80 = 0 - 2I_b + 2I_c \rightarrow (3)$

but $\boxed{I_\Delta = I_a - I_b} \rightarrow (4) \rightarrow$ sub in (1) and (6)

$\boxed{I_Q = I_b - I_c} \rightarrow (5) \rightarrow$ sub in (1) sub in (2)

$\boxed{I_c = 8I_\Delta} \rightarrow (6)$

$12 - 2(I_b - I_c) = 5I_a - 5I_b \rightarrow$

$-8(I_b - I_c) = -5I_a + 7I_b - 2I_c \rightarrow$

$I_c = 8(I_a - I_b) \rightarrow$

$12 = 5I_a - 3I_b + 2I_c \rightarrow (1)$

$0 = -5I_a + 15I_b - 6I_c \rightarrow (2)$

$0 = 8I_a - 8I_b - I_c \rightarrow (3)$

$12 = 2I_\delta + 5I_\Delta$

$6I_\delta = 5I_\Delta + 2I_\delta$

$10I_\delta = 5I_\Delta$

$2I_\delta = I_\Delta$

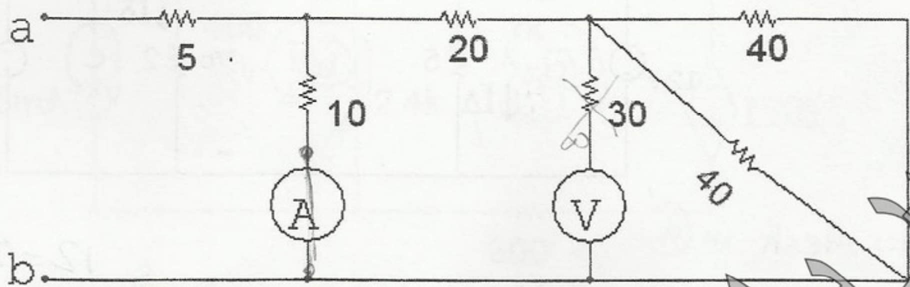
$12 = I_\Delta + 5I_\Delta$

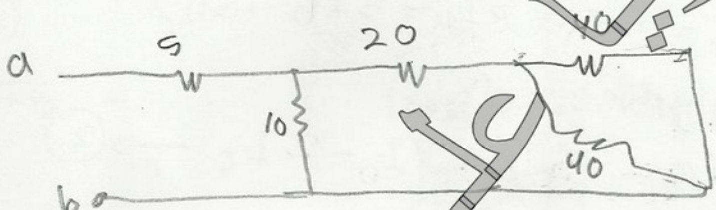
$I_\Delta = 2I_\delta$

5

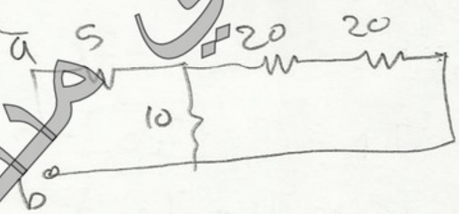
Question 2

a) Find Rab assume ideal instruments



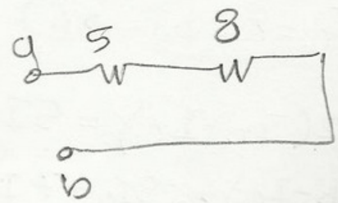


$40 \parallel 40 \quad \frac{40 \times 40}{80} = 20\,\Omega$



$(20 \text{ ser } 20) \parallel 10$

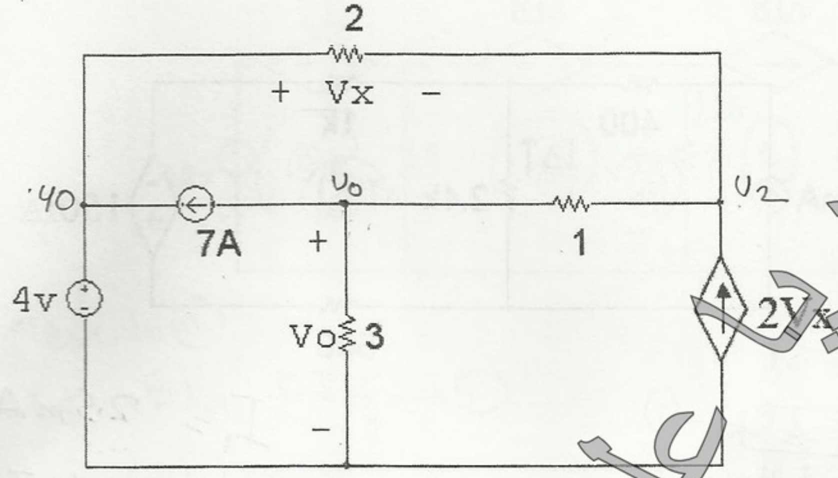
$\frac{40 \times 10}{50} = 8\,\Omega$



$5 \text{ ser } 8 = 13\,\Omega$

$R_{ab} = 13\,\Omega$

b) Use the node- voltage method to find V0



In nod U_o

$$\frac{U_o}{3} + 7 + \frac{U_o - U_2}{1} = 0 \rightarrow (1)$$

In nod U2:

$$-2U_x + \frac{U_2 - U_o}{1} + \frac{U_2 - 40}{2} = 0 \rightarrow (2)$$

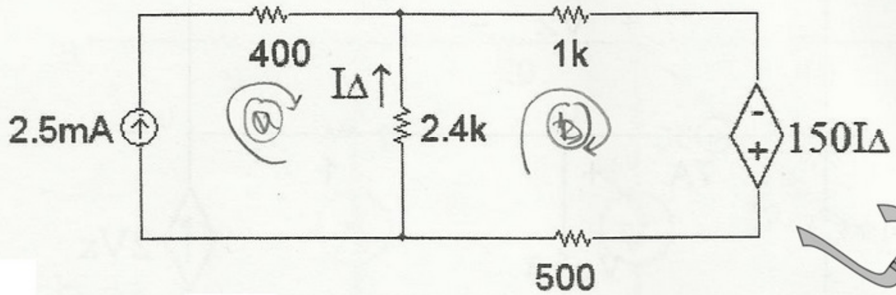
$$4 - U_2 = U_x \rightarrow (3) \quad \text{sub in } (2)$$

$$-2(4 - U_2) + U_2 - U_o + \frac{U_2}{2} - \frac{40}{2} = 0$$

$$-8 + 2U_2 + U_2 - U_o + \frac{U_2}{2} - 20 = 0$$

Question 3

a) Use the mesh current method to find I_Δ



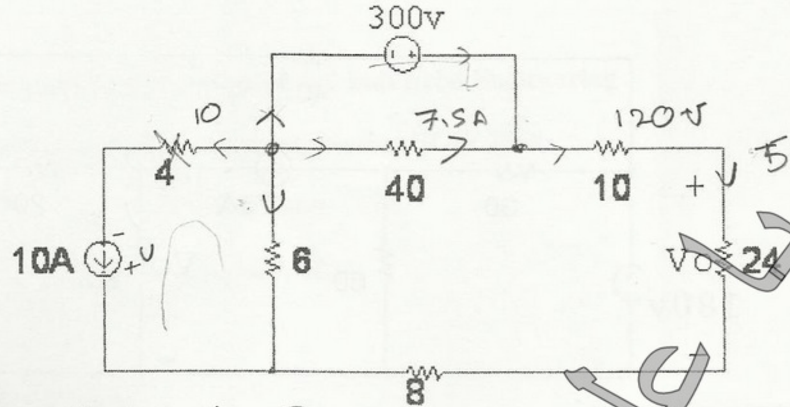
$I_1 = 2.5mA$

$150 I_\Delta = 2400 I_1 + 3900 I_2$

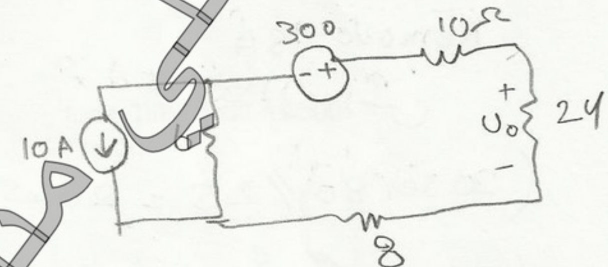
$I_\Delta = I_2 - I_1$

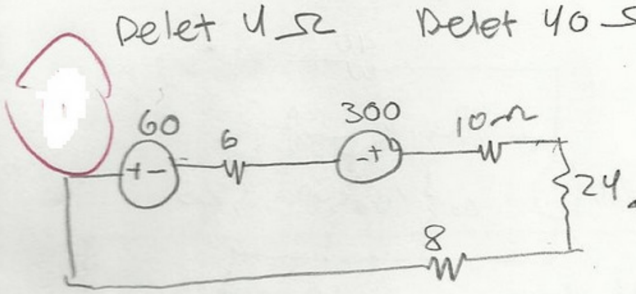
$I_\Delta = 1mA$

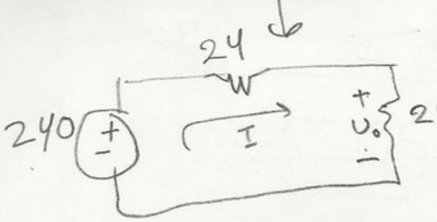
b) Use source transformation to find V0 , and the power developed in each source



Delet 4 Ω   Delet 40 Ω







$I = \frac{240}{48} = 5A$

$V_o = 24 \times 5 = 120\,V$

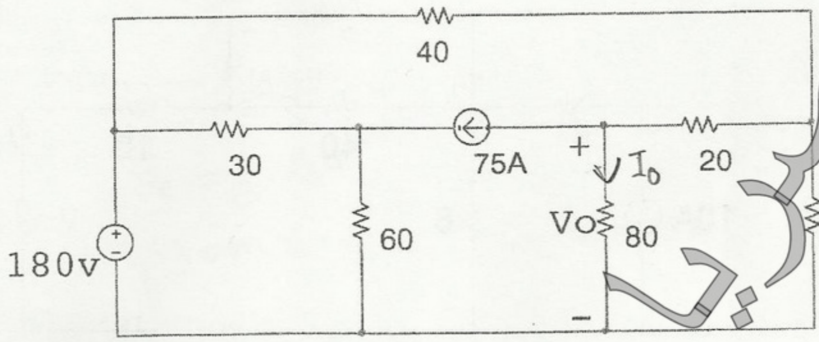
find power

$I_{40\Omega} = \frac{300}{40} = 7.5\,A$ $I_{300V} = 7.5 - 5 = 2.5\,A$

$P_{300V} = V \times I = 300 \times 2.5 = 750$ Watt

Question 4

a) Use superposition theorem to find I0 and V0



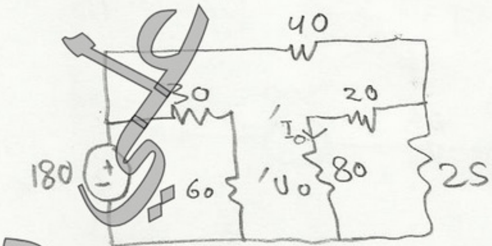
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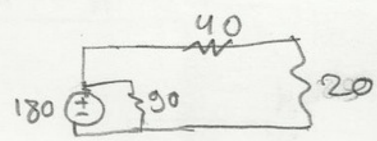
Remove 75A

تحول كل مصادر التيار الى دائرة مفتوحة

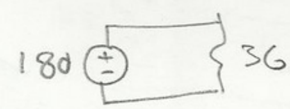
$(20 \text{ ser } 80) // 25 = 20\,\Omega$

$(20 \text{ ser } 40) // 90 = 36\,\Omega$





$I = \frac{180}{36} = 5A$



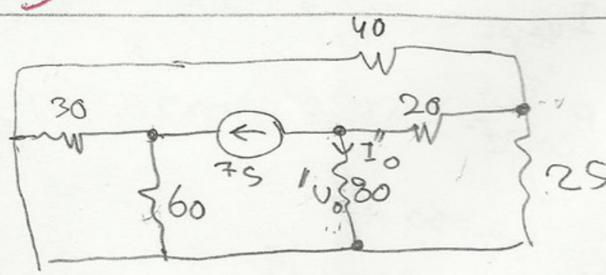
$I \text{ in } 60\,\Omega = \frac{90 \times 5}{60+90} = 3A$

$I_0' = \frac{3 \times 25}{100+25} = .6A$ $V_0' = 80 \times .6 = 48V$

By nod voltage

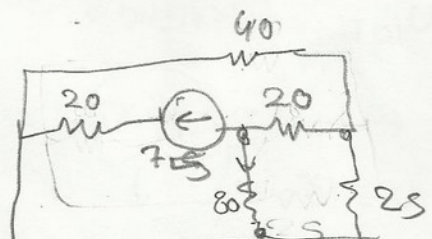
$R_{eq} = (25//40) + 20 = 35.384A$

$30//60 = \frac{30 \times 60}{90} = 20$



$\therefore I_0' = \frac{-75 \times 35.384}{80 + 35.384}$

$I_0' = -23A$ $V_0' = -23 \times 80 = -1841V$



(2) remove 75 soure to find V_0'' and I_0'' due 18v only

$R_{eq} = [(80+20)//25+40] // 30+60$

$R_{eq} = 36\,\Omega$

$I_T = \frac{180}{36} = 5A$

$I' = \frac{5 \times 60}{60+90} = 2A$ $I'' = 3A$

$I_0 = I_0' + I_0''$

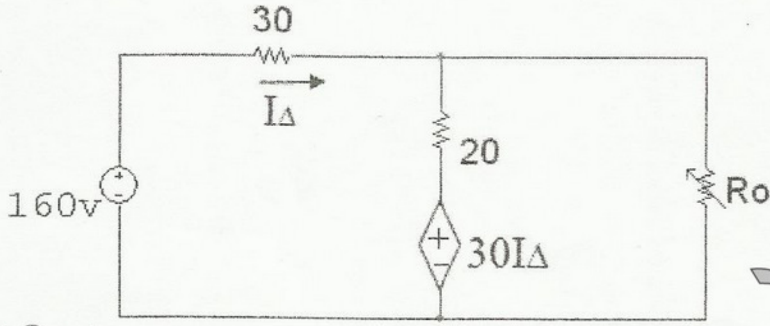
$V_0 = V_0' + V_0''$

$V_0'' = 0.6 \times 8 = 48V$

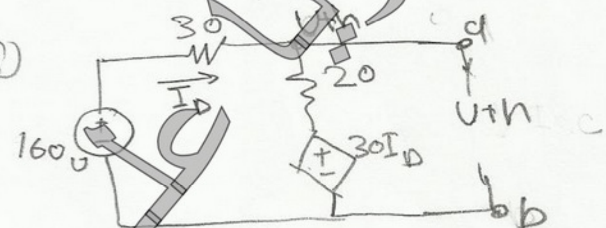
$I^0 = \frac{3 \times 25}{} = 0.6$

22.44A

b) The variable resistor R0 is adjusted for maximum power transfer to R0 find the value of R0 and the maximum power



$R_o = R_{th}$ at P_{max}



$$\frac{U_{th} - 30I_D}{20} + \frac{U_{th} - 160}{30} = 0 \rightarrow (1)$$

$$\frac{160 - U_{th}}{30} = I_D \rightarrow (2)$$

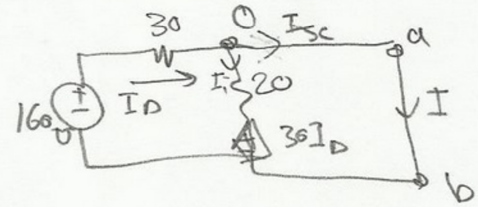
sub (2) in (1)

$$\frac{U_{th}}{20} - \frac{30}{20}\left(\frac{160 - U_{th}}{30}\right) + \frac{U_{th} - 160}{30} = 0$$

$$\frac{1}{12}U_{th} - \frac{160}{20} + \frac{U_{th}}{20} - \frac{160}{30} = 0$$

$$\frac{2}{15}U_{th} = \frac{184}{3} \qquad U_{th} = \quad V$$

$$R_{th} = \frac{U_{th}}{I_{sc}}$$



$$I_{sc} = I_D - I_1$$

$$\frac{0 - 160}{30} + \frac{-30I_D}{20} = 0$$

$$I_D = \frac{160}{30} = \frac{16}{3}A$$

$$I_1 = \frac{-30I_D}{20} = \frac{-30\times\left(\frac{16}{3}\right)}{20} = -8A$$

$$I_{sc} = \frac{16}{3} - (-8) = \frac{40}{3}$$

$$R_{th} = R_D = \frac{U_{th}}{I_{sc}} = \frac{460}{\frac{40}{3}} = 34.5\ \Omega$$

$$\text{max power} = \frac{(U_{th})^2}{4(R_{th})} =$$